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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/461,756	12/16/1999	HIROYUKI KANO	9438-0014-2	4231

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EXAMINER	
BAUMEISTER, BRADLEY W	
ART UNIT	**PAPER NUMBER**
2815	

DATE MAILED: 09/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/461,756	Applicant(s) Kano
	Examiner B. William Baumeister	Art Unit 2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Jul 7, 2003* .

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *5-16, 19, 22-31, and 33-36* is/are pending in the application.

4a) Of the above, claim(s) *5, 6, 9, 12, 19, and 22-31* is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *7, 8, 10, 11, 13-16, and 33-36* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 7, 8, 10, 11 and 33-36 rejected under 35 U.S.C. 103(a) as being unpatentable over Capasso '009 in view of Sze, Physics of Semiconductor Devices.

a. Capasso teaches a light detecting device wherein a $n\lambda/2$ well 11 is sandwiched between $m_{odd}\lambda/4$ barrier/well superlattice regions 12 for producing carrier localization above the barrier for carriers having an energy E corresponding to a wavelength λ (see e.g., FIG 2 and E6 of Fig 3). As explained in the previous rejections, upon appropriate bias to some higher energy, E' such that $E' \simeq 4E$, the superlattice will inherently satisfy the $\lambda(E')/2$ transmission conditions claimed. This inherent fact is evidenced by Capasso's express teaching that "[t]here are transmission resonances (not shown) for discrete energies corresponding to a semi-integer number of electron wavelengths across the well." (col. 3, lines 30-33) Regarding claims 10 and 11, as the generic expression, $n\lambda/2$, for the well 11 includes the specific situation of n=1 (i.e., $\lambda/2$), when the dimension is set according to this particular situation, the thickness of well 11 will necessarily satisfy the condition of being equal to this higher wavelength, $\lambda(E')$.

b. Capasso further discloses that this invention may be employed for a variety of photodetectors (col. 1, lines 5-35), but does not expressly state that it may be employed in a p-i-n

photodiode. Rather, Capasso only sets forth limited examples wherein the λ/4--λ/2--λ/4 wave interference structure is employed in a photoconductor: an n-i-n detector comprising two n+ doped ohmic contact regions sandwiching the quantum-wave interference structure that is provided in the sandwiched i-region.

c. Sze discusses photodetectors including NIN photoconductors and PIN photodiodes (pages 744- and 754, respectively). Sze also teaches that PIN photodiodes have a faster response time the NIN photoconductors. (See e.g., TABLE 1, page 746 and the associated discussion in the middle of that page.) Sze also teaches that photodiodes are superior to photoconductors for low-light-level detection (page 748), and that the PIN photodiode is one of the most common photodetectors because the depletion-region thickness (the intrinsic layer) can be tailored to optimize the quantum efficiency and frequency response (page 754).

d. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the Capasso quantum wave interference NIN photoconductor by replacing one of the n+ ohmic contacts with a p+ ohmic contact, thereby alternatively producing a PIN photodiode structure for any of the purposes of increasing the device's response time, using the device in low-light-level detection applications, and optimizing the quantum efficiency and frequency response as taught by Sze. It would have additionally been obvious for the skilled artisan to have included the Capasso quantum-wave interference structure in a conventional PIN diode for the purpose of obtaining greater carrier localization in the p-i-n diodes, as taught by Capasso.

3. Claims 13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Capasso/Sze as applied to the claims above and further in view of Motoda et al. '350. Capasso/Sze teaches all of the limitations of the claims as explained above except for the further inclusion of delta layers at the interface of the superlattices' barriers and wells. Motoda teaches that delta layers may be employed at the interfaces of a superlattice's barriers and wells for the purpose of more sharply varying the energy band profile at this interface. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to employ delta layers in the superlattice regions taught by Capasso/Sze for the purpose of more sharply varying the energy band profile, as taught by Motoda thereby further improving the desired reflection/transmission characteristic for which the superlattice is designed.

Response to Arguments

4. Applicant's arguments filed 11/1/2002 have been fully considered but they are moot in light of the new grounds of rejection.

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Schneider et al. '466 teaches p-i-n photodiodes having a MQW superlattice formed in the i-type detection region.

b. Yamazaki '893 teaches that the inventive concept of that photo-electrically-sensitive device may be employed in either a PIN detector or in an NIN or PIP detector.

INFORMATION ON HOW TO CONTACT THE USPTO

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister,** at **(703) 306-9165.** The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

B. William Baumeister

B. WILLIAM BAUMEISTER
PRIMARY EXAMINER

September 4, 2003